Optimal Object Categorization Under Application Specific Conditions

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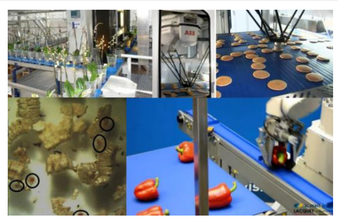
Goal of the PhD

*"Develop a **universal object categorization framework** that uses object-, application- and scene-specific **constraints** to reach **robust** and **accurate** object detectors while having a **minimal manual input**."*

Research problem

Industrial applications

- High intra class variability (size, color, texture, ...)
- Eg. robot picking, object counting, product inspection, ...
- *'In the wild'* → 85% detection → not enough



However

- Exploiting application specific constraints can increase detection rate
- Lead to smarter & better object categorization techniques
- Focus on known parameters like camera position, lighting conditions, object location, object size range, …

Outline of objectives

During the PhD we will focus on three objectives, in order to create a single universal semi – automatic object categorization framework.

1. A high detection rate of 99,9% or higher

- Demand of industrial partners, where classic techniques still fail
- By integrating extra application specific knowledge

2. A minimal input during the training of an object model

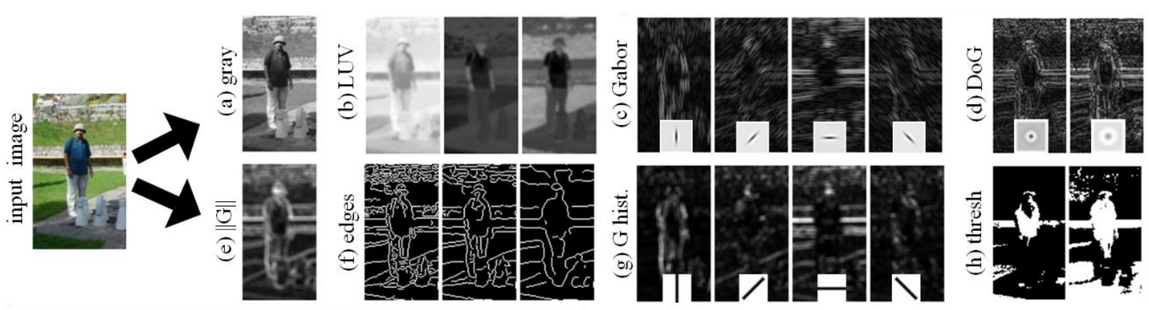
- Classic techniques use thousands of positive and negative samples
- Use knowledge to smartly select meaningful training images
- Iteratively switch between annotating and training object models

3. A faster and more optimized algorithm

- Adding more functionality like extra channels = more processing time
- CPU & GPU optimizations for real time processing

Methodology

INTEGRATION OF SCENE AND OBJECT VARIATION



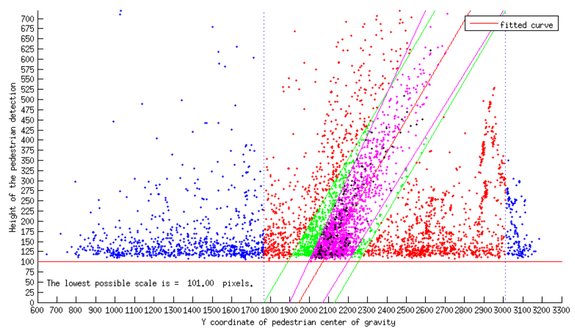
1. Collecting as much data input channels as possible

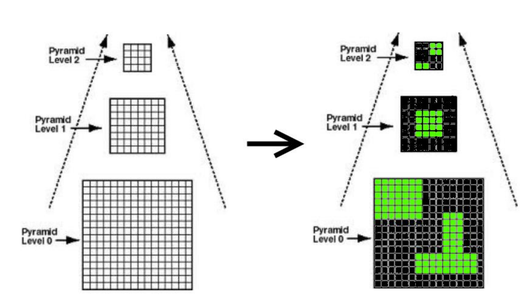
- Eg. channels used by Dollár ChnFtrs framework
- Giant pool of features, possible to expand when needed
- Boosting will select the useful features for the application

2. Focusing on four feature pools specific to our applications

- Influence of object scale and position
- Influence of lighting, color and texture
- Influence of background clutter and occlusion
- Influence of rotation and orientation

Calibrating location into a 2D lookup function + using a segmented scale-space pyramid





Use of color and texture information to retrieve object specific information

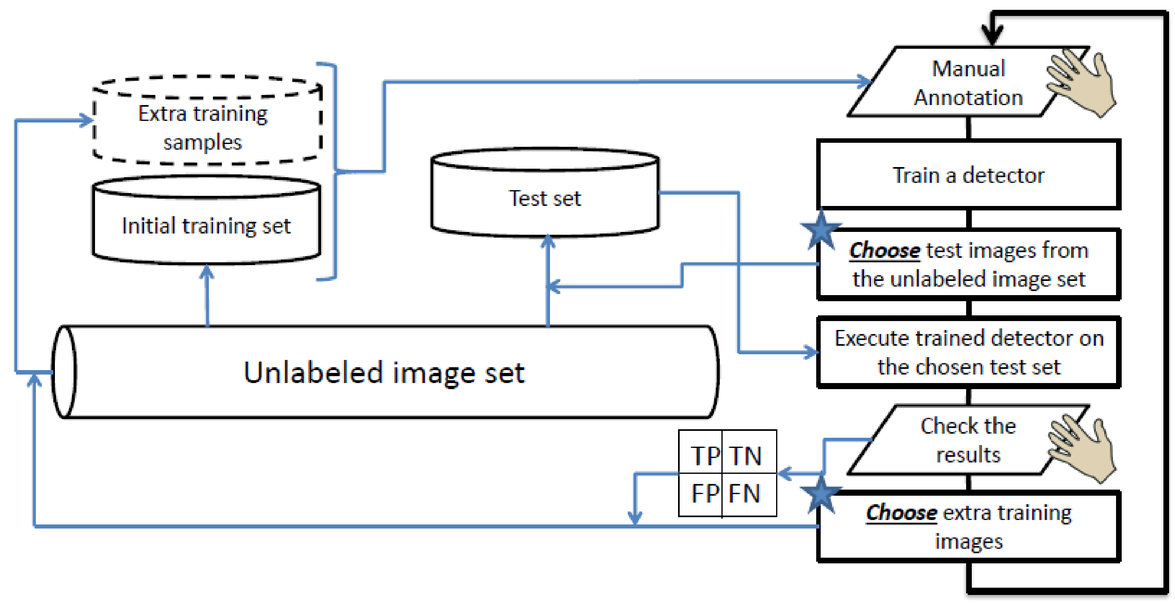
- Use of Fourier frequency spectrum
- Look for reoccuring textures to identify objects compared to background information

Use of orientation to be able to make a single detection on each image patch

INNOVATIVE ACTIVE LEARNING STRATEGY

Making use of a iterating active learning strategy that uses the application specific information gained from object and scene variation

- Results in less manual annotation and intervention
- Only the useful training samples will be added to the system
- Try to find *'border'* samples by using the application specific knowledge



Current results